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T H E
H I S T O R Y
A N D
C H E M I C A L A N A L Y S I S
O F T H E
M I N E R A L W A T E R
L A T E L Y D I S C O V E R E D I N T H E
CITY of GLOUCESTER;

T H E
V A R I O U S D I S E A S E S T O W H I C H I T I S A P P L I C A B L E
C O N S I D E R E D ;

A N D T H E N E C E S S A R Y R E G U L A T I O N S F O R D R I N K I N G I T
W I T H S U C C E S S A S C E R T A I N E D A N D P R E S C R I B E D.

By J O H N H E M M I N G, M. D.

PHYSICIAN TO THE OSSULSTON DISPENSARY,

MEMBER OF THE ROYAL MEDICAL,

A N D

Honorary Member of the ROYAL PHYSICAL SOCIETIES of
EDINBURGH.

L O N D O N :

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M D C C L X X X I X.

[PRICE ONE SHILLING.]

E R R A T A.

Owing to the hurry in which these pages have been committed to the press, the following particular errors have been committed:—In page 38, line 9—The quantity of air remaining from the whole, which was not affected by lime-water, amounted to 20 ounces—instead of which, read 30; and in line 21, instead of 28, read 18 ounces. These two inaccuracies must make an alteration in page 50, line the first, viz. instead of 28, read 72 ounces.



TO THE
INHABITANTS
OF THE
CITY of GLOUCESTER,
AND ITS VICINITY.

IN dedicating these pages to you, I should be wanting in my duty, did I not offer some apology for the inelegant manner in which they appear; but when the difficulty of the undertaking is considered, together with the short time allotted me, I may claim perhaps your indulgence; especially should it be found, that my inaccuracies are in language, rather than in the more essential part of my subject—the experiments and deductions.

That they have been stated with truth, and the conclusions drawn according to reason, is in the power of others to prove.

Permit

DEDICATION.

Permit me, then, to congratulate you in the possession of so valuable a remedy as this water is likely to prove. And I make no doubt that its celebrity, joined with the attraction of your polite and elegant manners (which I take this opportunity with pleasure to testify and acknowledge) will soon render THE CITY OF GLOUCESTER a place of fashionable resort.

I remain, with respect,

Your most obedient,

humble Servant,

June 27th, 1789.
No. 54, King-Street,
Argyle-Buildings.

JOHN HEMMING.

THE

T H E
H I S T O R Y, &c.

C H A P. I.

PREVIOUS to my entering upon any part of this treatise, I think it will not be unacceptable to my readers if I make them in some measure acquainted with the city of Gloucester and its environs, together with the advantages that strangers may derive from the salubrity of its situation; to which I shall subjoin an account of the origin and history of the Mineral Water, which is to form the subject of the following pages.

Gloucester is a city of great antiquity, and considerable opulence. Though a large town, it is remarkably healthy. It is a known fact, that infectious fevers scarce ever make their appearance amongst its inhabitants; and if ever such diseases arise, that their progress is always confined to a very few subjects; which are in general such of the poor as are predisposed to fe-

vers by want of cleanliness, and various irregularities.

The healthfulness of the town may be attributed to several local advantages. In the first place, its streets are spacious, and intersect each other at right angles; and this circumstance, added to that of the houses not being built of too great a height, is exceedingly favourable to free ventilation. Nor are the currents of air obstructed by gateways, projections, &c. all such nuisances having been lately removed by the authority of parliament; and at the same time the streets were paved, and provision made for lighting them.

The center of the city stands on a more elevated site than either of the extremities; and there is a gradual descent from it in every direction, by which means filth of all kinds is readily washed away, and water is prevented from stagnation.

Another cause of this peculiar salubrity is the influence of the tide in the Severn, which runs close by the town; and, in consequence of the form which its banks assume, at a small distance from Gloucester, and nearer to the sea, the tide comes up to the town in a singular manner,

manner, and with a boisterous impetuosity. When we consider how much the agitation of water conduces to the purifying of the circumambient air, we may readily assent to the popular opinion, that Gloucester is rendered healthy by the tide.

A third cause may be assigned in the respective situation of the neighbouring hills which surround the town at a moderate distance, forming, as it were, a spacious amphitheatre. The effects of these eminences on the neighbouring vales are well understood by naturalists. In Robin Hood's Hill, the property of Mr. Selwyn, are formed large reservoirs of pure water, which is conveyed by aqueducts to the town, and supplies most of the houses.

No city in England is less infested with vagrants and disorderly persons; a felicity, which is partly to be attributed to the good habits of the better class of citizens, which, of course, influence the manners of their inferiors; and partly to the excellent police of the magistrates, which diligently exerts itself in suppressing disorders within the town, as well in vigilantly attending to all vagabonds, and strangers of a suspicious appearance.

The common manufacture of the town is pin-making: Much indeed to be commended, on account of the great numbers of poor of all ages and sexes, which it supplies with labour and with bread. It were, however, greatly to be wished that it were a more healthful occupation. In most of its branches it is very dirty, and requires a sedentary life; therefore, if temperance and cleanliness be not strictly adverted to, it must frequently injure the health of the manufacturer, as well by the effects of his confinement, as by his swallowing and inhaling the metalline particles.

In speaking of Gloucester, I cannot forbear mentioning, that here originated the popular institution of Sunday-schools; the first of the kind being established in one of its parishes, by the joint labour and expence of the reverend Mr. Stock, and Mr. Robert Raikes; the former a clergyman, whose abilities and manners do honour to his order; the latter distinguished by his attention to the condition of the poor, and his indefatigable exertions to promote the progress of this institution throughout the kingdom.

Adjoining to the city has lately been erected a spacious and well-built county goal, which is
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constructed so as to produce every effect of secure confinement, punishment, and reformation that can be found in a prison ; and probably the provisions which have been made for keeping it clean and well ventilated, will for ever preserve its miserable inhabitants from generating and communicating the dreadful poison of the goal-distemper.

The finest feelings of humanity will be amply gratified by surveying the general infirmary in the suburbs of Gloucester ; an institution, the support and the management of which does the highest honour to those by whose munificence it is maintained, and by whose care it is regulated. It frequently provides, at one time, for the relief of nearly one hundred and forty patients in the house, besides a proportionable number of out-patients.

The same degree of neatness, cleanliness, and good order prevails in this hospital, which is to be desired in the best conducted private family ; nor is any relief withheld from the bed of sickness, which expence, care or attention can administer.

Unfortunately the annual expences of the charity always exceed its *certain* income ; but it is

to be hoped that the deficiencies will never fail of being made good by the *benefactions* of those, who possess benevolence as well as riches. In justice to those employed in the medical and chirurgical department, it ought to be mentioned, that the objects of this *public establishment* are attended, and have their medicines dispensed, with all the punctuality and exactness of *private practice*.

The stranger, who resides a short time in Gloucester, is surprized that more manufactures are not established in a town, whose situation has been always well adapted to them; and has of late been more particularly so, by a ready communication with every part of the kingdom, and, of course, with all the world. The lately-effected junction of the Severn with the Thames, in this county, a work which will be a lasting monument of a wonderful exertion of persevering industry, gives Gloucester an opportunity of conveying goods by water to London, Liverpool, Hull, and other great commercial places.

Prior to the accomplishment of this work, it had a free intercourse with Bristol, and with most parts of Wales; and, in short, with every coasting and inland part of the country to which the Severn, or any river communicating with it, had

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an access; so that the town is now eminently well fitted for any undertaking which requires the carriage of heavy articles; as for instance, sugar-baking, breweries, vinegar-making, &c.

The soil of the city, on the east and north sides, and partly on the south, is for the most part gravelly. On the west it is principally marl or clay. Last year, a gentleman, in digging a well of a considerable depth, in this quarter of the town, found several marine fossils, in which ferrugineous particles were blended with the other substances. Besides these he found only different coloured strata of marl and clay.

Several situations in and about the town are admirably calculated for the building of new houses, on account both of their pleasantness and salubrity; especially in Barton-street, which is on the east of the town.

New markets, both handsome and commodious, have been lately erected, and are well supplied with all kinds of provisions, and for the most part at reasonable prices.

The ancient and beautiful cathedral will not go unnoticed by the curiosity of any visitor; but to give a description of this edifice, or to treat of other objects worthy of notice in and about the

town, would be to extend this treatise beyond its proper limits.

The spring, of which I am now to give you the history, will, I make no doubt, contribute to the advantage and prosperity of this town: This water was first taken notice of about forty years ago, by a gentleman, who, when building the mansion now occupied by Mr. Lewis, ordered a well to be sunk; and soon found that the water of this spring differed much from that of the town; but, owing to his being advanced in years, and at the same time thoroughly independent, did not think it an object worthy his attention, although well apprized of its medicinal virtues. The same reason prevented his daughter, who lived in it long after his decease, from making any advantage of it; and was by them totally neglected, as by no means fit for domestic purposes. In November, 1787, the present tenant took possession of the premises, and used this water for the first eight months while in the house, having no other, without going some distance; he all the time perceived it to be in every instance peculiarly different from any other; but as he was unacquainted with the reasons, he was constantly mortified by finding it totally unfit for

for every purpose for which he wanted to apply it. He has informed me, that the linen washed therein was spoiled ; and the water, when boiled for tea, used in brewing, or other culinary purposes, produced such disagreeable effects, as to defeat the intention for which it was used. The first cause which led him to consider it as a medicinal water was, that a lady, then a lodger, upon mixing it with brandy, observed that a much higher colour, and an appearance totally different from mixing the same with ordinary water, were produced ; from which circumstance she never used it afterwards, but obtained water from another part of the town. After he had lived some time on the premises, his wife, who had long laboured under nervous complaints, attended with a variety of symptoms, such as dejection of spirits, langour, &c. and, having applied to medical men of note in Bristol, Bath, and Gloucester, without success, at last determined to try the effect of this water ; and in a few weeks her complaints greatly abated. The daughter was so violently afflicted with the scrophula, or King's Evil, that she was at times blind, and loaded with ulcers, to the amount of thirteen in number, the marks of which are now to be seen. She was
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pronounced by the faculty incurable, and had used the Malvern waters without effect; but by the efficacy of this mineral spring was, in a short time, greatly relieved.

Some time after this a professional gentleman travelling with the bishop of Cork, being convinced it possessed medicinal virtues, strongly recommended it to a lady of their company, much affected with (as was termed by them) nervous weakness; she regularly used it for a fortnight, and great benefit was received.

From this time it was suggested to the proprietor to have the water conveyed into a small room by means of pipes, which he did, then advertised its virtues, and gave free access to all who came; and upon a moderate calculation (as I am told) 400 persons assembled of a day, most of whom received great benefit, and many cures were accomplished; a few particular cases of which I shall mention at the end of this treatise. Since the last summer there has been added a very large and commodious pump-room for the nobility and gentry; the former pump being reserved for the poor, who by applying will still receive great attention as before.

I shall

I shall now lay before my readers the plan which I propose to use in the following treatise. I shall give an account of the general and particular experiments which were made, in order to acquire a proper knowledge of the contents of this water. 1st. From each experiment separately, and afterwards collectively.

2dly. From the experiments made and conclusions drawn, I shall give an account of every disease in which this mineral may be of service, together with certain principles, founded upon practice, why such relief should reasonably be expected.

3dly. I shall lay down certain rules for invalids, with respect to the regimen to be observed while making use of the water, together with observations with respect to the quantity, times, and seasons, for drinking the same.

I shall conclude the whole by relating a few well certified cases, where relief and cures have been obtained.

C H A P. II.

AS water is universally known to be a solvent for a great variety of bodies in nature, it is easy to conceive that by passing through the bowels of the earth, it may meet with some one or more with which it may unite, and thereby suspending the integrant parts of the same, may produce a solution; hence the name or epithet of mineral has been, with propriety, given to those waters which have become impregnated with any heterogeneous matter that they may have accidentally met with in the course of their passage, whether flowing within or upon the surface of the terrestrial globe; yet, as there are few waters, even amongst the most pure, but what are impregnated with some substance, or earth, this would give rise to too vague and extensive a definition; therefore I think it necessary to confine the name of mineral waters to those which, by having passed through certain veins of the earth, have dissolved a sufficient number or quantities of matter, which may produce a sensible effect on the animal

animal œconomy, and thereby be rendered capable of curing or preventing certain diseases, to which the human frame is daily exposed.— From the above definition, the waters of the sea, and saline springs, although not generally enumerated amongst mineral waters, nevertheless ought equally to be considered as such; for besides earthy and selenitic matters, they also contain a large quantity of mineral salts.

As chemistry is a science which teaches the effects of mixture and of heat upon all bodies, whether natural or artificial, with a view to the improvement of arts, and of our knowledge of nature *; it is that upon which all our principles for the investigation of the component parts of mineral waters are founded. From the above definition of chemistry my readers will naturally conclude, that there are two leading guides for our arriving at such a knowledge, viz. that of mixing different substances, by which new compounds will arise; or, by the sole application of heat.

To such as may be unacquainted with the science of chemistry, it may be necessary to explain

* This definition is given by Dr. Black, in his Lectures on Chemistry.

the nature of these two principles; the first of which is founded on a simple fact; I mean, that all bodies have not an equal disposition to unite with one another; but that there is a manifest gradation among all bodies in their tendency to form a union with each other; owing to this circumstance, the component parts of many compounds may be separated by the addition of a third body, which has a stronger attraction for the one of them than they had for each other when in a state of union; a decomposition takes place, and a new combination is effected. *E. G.* If with any acid, such as the acid of nitre, calcareous earth, or chalk, is combined, the latter can be separated by the addition of an alkali, which unites with the acid, and separates the chalk; and as in many, or most of these cases, the body thus separated falls down to the bottom of the vessel, such bodies have been called precipitants *. The second principle, viz. the application of heat, is founded upon our knowledge that bodies differ in volatility; hence the more volatile are separated from the fixed by the ope-

* These, when made use of in the analysis of waters, have been commonly termed chemical tests.

ration of distillation, and can be afterwards examined apart. If the heat is so long continued that the whole of the fluid is evaporated, the solid contents remain behind, and the analysis is said to be made by evaporation.

Each of these methods was employed in the following analysis; and I shall now, first, give the general characters of the Gloucester water, and then proceed to relate my experiments, which were first made in a general way.

1st. The Gloucester water, when first taken from the pump, and poured from one vessel to another, emits numerous little bubbles of air, which attach themselves to the inner surface of the glass, and rise up to the top, assuming a brisk sparkling appearance. By accident, a circumstance occurred, when I was not engaged in making any particular experiment, I filled a large glass jar with this water, and inverted the same over a tub containing more water, by which means all communication with the external atmosphere was excluded from the interior part of the jar; it continued in this situation a whole night, and the next morning I was much pleased with a very beautiful appearance; the whole surface of the jar was lined with vesicles of air, which,

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by uniting particularly at the top, formed (if it may be allowed the expression) a most beautiful shell-work of air, in the thickest clusters imaginable.

2d. Colour.—This water is never transparent, but at different times more or less turbid; in general it has a whitish cloudy appearance.

3d. To the smell it is rather inodorous.

4th. Taste.—When drawn it is rather brisk, pungent, and refreshing; afterwards rather austere, or rough, resembling ink; but with respect to this quality, those who make a point of attending the Spa, in a regular manner, will agree with me, that to the taste it differs so very greatly, that hardly any two days together is the strength the same. I shall have more particular occasion to take notice of these frequent changes in the course of my experiments to be hereafter related.

5th. After being left in an open vessel for a few hours it loses entirely its pungency and briskness; its roughness is greatly diminished, and it deposits a sediment; hence, unless it is put into bottles well corked, it loses great part of its medicinal virtues.

6th. This water is to be ranked among those which are called cold; because, whenever the
thermo-

thermometer is immerfed in any quantity, it constantly finks 8 degrees below the temperature of the atmosphere.

7th. Its fpecific gravity differs little from that of common water; if any thing, it is heavier.

I fhall now proceed to inform my readers what the fcience of chemiftry pointed out to me in my experimental enquiry made at the pump.

The principal chemical tests, or precipitants, made ufe of in the courfe of my experiments were,

1ft, Syrop of violets, and infufions of different blue and purple vegetables; all of which, when added to pure diftilled water, are known never to produce any effect; but if poured upon waters impregnated with an acid, are changed to red; if an alkali prevails, to green;—the nicelt test to prove the predominance of either, is the tincture of lithmus. Although the fyrop of violets has long held a place as a test of acid, or alkali, Profeflor Bergman is difpofed to reject it altogether, as it is fubject to fermentation, and is not always fufficiently fenfible of the aerial acid in water: this was tried with the Gloucefter water, and the effect produced was not fufficient to fpeak with a proper confidence. With the

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tincture

tincture of lithmus a very visible effect was produced, I mean the change to red, which however only took place when the water was first drawn ; and after it had been thus changed and exposed to the air for a few hours, the colour gradually diminished. Hence we may conclude, that the acid predominant in this water is of a volatile nature, which escapes upon exposure to the air. Archil produced the same effects.

2d. A solution of soap was decomposed by the water, visible from the curdling of the same, which might be owing to the water containing any acid, either in its separate state, or combined with an earthy or metallic body ; because the alkaline part of the soap unites with the acid, for which it has a greater affinity or attraction than the oil with which it was before combined. It is necessary to observe on this occasion, that the water was much more capable of making a lather with soap after it had been some time boiled, yet not so well as river water :—this is another argument in favour of what I before advanced, relative to the acid being of a volatile nature.

3d. Upon the addition of vitriolic an effervescence was produced, which might be occasioned by its uniting with some one or more of the substances,

stances, in preference to the acid with which they were previously combined.

4th. Oil of tartar per deliquium, now called aqua kali, poured upon this water, produced a white cloud, and afterwards a sediment, which was rendered clear upon the addition of a few drops of vitriolic acid. Spirit of sal ammoniac produced the same effect, and the water was again rendered clear by the addition of any acid. From this experiment I was naturally induced to suspect the presence of an absorbent earth, either calcarious or magnesia, which was disunited from its acid, owing to the alkali having a greater attraction for it than either of the absorbents had, which was consequently precipitated, but re-dissolved by the addition of more acid.

5th. The caustic volatile alkali, or aqua ammoniæ puræ, produced a precipitate of a brown colour, approaching to an ochreous nature.—The caustic fixed alkali, or solution of kali purum, produced a precipitate of two different colours, white, slightly intermixed with brown.

From the foregoing experiments we have sufficient reason to assert, that the effects produced were owing to an acid existing in the water which is itself fugitive, as it escapes by exposure to the

air, and is easily separated by the addition of a third body, which unites with one or more of the substances therein contained: for were the same experiments repeated on distilled water, no such effects would arise; nor could any earth, whether calcareous, magnesian, aluminous, or metallic, be suspended, unless there was present some acid, either in the form of aerial gas, or in that which is natural to the acids in general; but neither of these experiments have yet given us any knowledge of the nature of the acid which keeps the particles of the different substances suspended, nor of their nature when separated.

6th. The next test I made use of was lime-water; when dropped into any quantity of the Gloucester water, it produced at the instant a plentiful thick white cloud, which could be owing to no other cause than that of the lime's uniting with some acid, which rendering it insoluble, were both thereby precipitated, either in the form of chalk, if fixed air was present—or gypsum, if vitriolic acid; because lime has a greater attraction for fixed air than any other body, terra ponderosa excepted; and it could not separate any body united with the vitriolic acid, except magnesia, and the metals which might be known by the colour

four of their precipitates. For the use of this test, in the analysis of waters, we are much indebted to Dr. Black, professor of chemistry in the university of Edinburgh, whose experiments on calcareous earth and magnesia have so much increased our knowledge of the nature of fixed air, both in its separate state, and when combined with other bodies, as also of the different degrees of attraction it has for various chemical bodies, that he has excited an ardour for new discoveries, and thereby formed one of the most brilliant epochs, in his science. We have reason then to expect, that the name of Black should always remain memorable in the annals of chemistry, and be handed down to posterity as long as the science itself shall exist. From his experiments it is now known, that lime owes its solubility in water to its being deprived of its aerial gas, known commonly by the name of fixed air, and to possess the properties of an acid; that if to this solution this gas is added, the lime is separated and re-assumes the form of chalk, which being insoluble in water falls to the bottom, and forms the precipitate above-mentioned. He has proved that lime has a greater attraction for this air than for either the vegetable, fossil, or volatile alkalies.

From the last mentioned experiment made on the Gloucester water, there is reason to impute the white precipitated matter to the fixed air being united to the lime, which is thereby rendered insoluble, and reduced to the state of calcareous earth, natural to it, previous to its calcination.

It may at first appear unintelligible to some of my readers, why this aerial acid should render calcareous earth insoluble, when I have just mentioned that it is by means of the same that it is kept in solution; I will, however, endeavour to explain this, by informing them of one single fact, viz. that although lime is made insoluble by fixed air, which renders it the same as chalk, yet, by the introduction of a greater quantity of the same acid, it is re-dissolved; the lime-water, therefore, when mixed with waters containing fixed air, will imbibe all the superabundant quantity, and the lime will thereby be rendered insoluble.

The presence of fixed air as an acid will account for the change produced upon the infusion of lithmus, and the solution of soap; because, when the water was exposed to the air, the acid escaped in its uniform state. That there is another acid which suspends the particles of other
bodies

bodies in this water, will be rendered manifest in the course of some subsequent experiments.

7th. I next tried the effects produced upon the water by a few drops of an infusion of galls. The effects varied at different times. I have been able one day to produce a very deep purple, although upon another trial a much slighter change was occasioned. This astringent vegetable, whether made use of in the form of infusion by water, or tincture made by spirits of wine, readily discovers iron, and slowly precipitates it from water; in proportion to the quantity of iron therein contained, the colour produced is more or less purple. It is almost needless for me to make any comment upon this experiment, as the property of its infusion, or tincture, producing a change in any water containing iron, is so well known to those who are ever so little skilled in the science of chemistry. Dr. Forthergill, in his Analysis of the Cheltenham Water, observes, that the colour of this precipitate varies according to the nature of the acid by which it is suspended. If the iron be vitriolated, the precipitate is of a dark blue, inclining to black; if the iron is aerated, that is to say, suspended by aerial acid, a purple is produced. In my experiments the lat-

ter always took place ; which circumstance, joined with others hereafter mentioned, prove that the iron in this water is aerated. The same effects as with the galls I produced by infusions of tea, and various others astringents, although differing in degree ; from which I can have no doubt of iron being combined with the water.

8th. The phlogisticated, or Prussian, alkali was next made use of as one of the nicest tests of the presence of iron contained in any water, which it discovers by producing a beautiful Prussian blue, whenever it comes in contact with this metal ; but in order to accomplish this end, an acid is always necessary. These two, when poured on the Gloucester water, caused this effect ; and the liquor, after having been set by for a short time, deposited a fine powder.

But as the Prussian alkali is the most delicate test of the presence of iron in any liquid, it may, from this circumstance alone, give rise to false and erroneous conclusions, unless two particular points are attended to. 1st, Great care must be taken in the choice of the vitriolic acid, which is made use of in separating the colouring matter from the alkali ; and, 2dly, The preparation of the phlogisticated alkali requires much circumspection ;

spection; the reasons for which will appear from the following facts: It would be foreign to a work of this nature to enter into a theory of the making of Prussian blue; nevertheless, a few observations are necessary.—First, Neither the vitriolic, nor any other acid, singly, has any action upon the colouring matter combined with the alkali.

Secondly, Iron will no more produce a precipitate from the alkali than the acid, yet they are both necessary to produce the desired effect; because the united affinities of iron and acid act together on the compound of the alkali and the colouring matter; the iron seizes on the latter, with which it forms the Prussian blue; the vitriolic acid being then set at liberty, combines with the fixed alkali, and forms with it a vitriolated tartar; therefore two decompositions take place; and, consequently, two new combinations are effected; this then is an example of double affinities, as being produced by the mixture of four bodies.

As this alkali is so useful a precipitant for the discovery of iron, we must first be certain of the nature of the acid employed to separate the colouring matter. The vitriolic acid may contain a small quantity of iron, because a great part of this acid, which is bought from trading chemists,

is often distilled from calcined vitriol; in which operation a small portion of the metal therein contained may arise with it; which acid, when added to the Prussian alkali, in any liquid, may give rise to a false assertion, that iron was contained in the water, although in reality this metal was combined with the acid.

The second circumstance to be attended to, is the preparation of the alkali for this purpose; which is made by calcining equal parts of vegetable alkali with ox's blood; the residue is then put into boiling water, in order that the saline matter may be dissolved; the liquor is then filtered, and a phlogistic alkali lye is obtained. Various have been the theories formed upon the effects produced by this alkali, when applied to mixtures wherein iron is contained: and I may even now say, that very little is known respecting it.

Mr. Fourcroy, in his treatise upon the nature of mineral waters, and their analysis, has entered at some length upon the use of this alkali, as a test in discovering their contents; and says it is by no means to be relied on, because it may contain a small portion of iron. He considers its colouring matter to be of an acid nature, which can be united with alkaline substances; this idea
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has suggested to him the means of producing a Prussian alkali, entirely free from the least particle of iron, and will be the most certain test of its presence in water : this process consists in digesting Prussian blue with lime-water ; the blue then assumes the appearance of rust, and the lime-water a beautiful yellow colour ; it is then filtered, and has lost every characteristic mark of an alkaline nature ; that is to say, it is neutralised by the acid colouring matter which formed blue, and thereby becomes a nicer test of the presence of iron, owing to its not containing the smallest particle of that metal. I have made use of this preparation and the common alkali in the following analysis, and the blue was always produced ; neither of which, when added to distilled water, produced any effect.—I thought myself in some measure obliged to enter upon this subject at a greater length, owing to my having been frustrated in some of my experiments at Gloucester, when made before a professional gentleman of established character and distinguished abilities ; the difficulties which then occurred I promised to explain ; I have therefore endeavoured to satisfy him on this subject. I might possibly be more
able

able to do it, was I permitted (which would be thoroughly incompatible with a work of this nature) to enter fully into the theory of any particular object in chemistry.

I made use of one more test, in order to be certain of the presence of iron; which was, the introducing, by means of an apparatus, to be hereafter mentioned, a quantity of Hepatic gas into an inverted vessel, full of water; in proportion as the air ascended, the water made its escape. I stopped the process when nearly one half of the water was separated, the upper part was then full of air, and the under contained the remaining water. I then removed the vessel carefully, avoiding any communication with the atmosphere; and, after repeated agitation, in an hour the water was changed to a deep black colour, from its having imbibed a portion of the gas. It is the property of this air to change the colour of all metallic calces, which, according to the explanation of the advocates for phlogiston, is owing to the phlogistic vapours of the sulphur uniting with the calx, and thereby reviving the iron in its metallic form. Or, according to the antiphlogisticians, is explained by the Hepatic gas decomposing the calx,

calx, and absorbing the oxygenous* principle, which is necessary for the calciformed state of all metals; which, being separated, the metal re-assumes its natural and most simple form. Let either of these theories be right, the fact is the same, and is generally considered as a proof of the presence of some metal; and, from the two former experiments, we need have no doubt that it is a calx of iron.

I shall now proceed to the precipitants made use of to discover the nature of the acids which might be united with the different substances. Upon pouring a few drops of a solution of silver in nitrous acid, a white cloud was produced, which might arise from various decompositions of saline or earthy substances taking place; the difference in appearance is various, because this acid will unite with any of them in preference to the silver; and the silver would unite either with the vitriolic or muriatic acids, in preference to the nitrous.

When the silver unites with either the vitriolic acid or marine, forming with the latter an inso-

* This is derived from the Greek, viz. *ὀξύς*, acutus; & *γίνομαι*, facio.

lubie compound, called Luna Cornea, the precipitate assumes the form of streaks; whereas in the decomposition of earthy bodies, a more general cloud was produced. The former effect took place in my experiments: hence I conclude the precipitate was formed by the silver uniting with one of these acids, in preference to the nitrous. The difference of this may be known to experienced chemists. I have generally observed that the precipitate formed under the name of Luna Cornea, sooner assumes a black colour when exposed to the light of the sun.—I speak not to a certainty.

In order the better to discover the nature of the acid, I made use of a solution of mercury in the nitrous acid, which is decomposed whenever it meets with the vitriolic or marine acids; whether single, or combined with other substances, the mercury quits the nitrous, and unites with either of the former; the nature of which is easily known by the colour of their precipitates; that formed by the mercury uniting with the marine acid is white, while that of the vitriolic is yellow, and known by the name of Turbith Mineral. In all my experiments a yellow precipitate was obtained when this solution was mixed
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with the Gloucester water. But for this purpose the solution of mercury ought to have a superabundant quantity of acid; for this solution, when perfectly saturated, forms a precipitate with even distilled or any other water; and it is upon this account that a solution of mercury, made without heat, is recommended in preference to the one made with heat. This was attended to in the analysis of this water.

To be still farther certain of the nature of this acid, I made use of a solution of *Saccharum Saturni*, or sugar of lead, which produced a white cloud; this might also be owing to several decompositions taking place; as calcareous earth, or an alkali, would have had almost the same effect: but this precipitate is easily distinguished by the addition of a little distilled vinegar, by which it would have been re-dissolved; whereas, was the separation formed by the lead with the vitriolic acid, it would have remained insoluble. From the two last experiments we have sufficient reason to assert, that another acid is combined with some of the solid contents in this water, by means of which they are kept suspended, and that there can be no doubt of its being the vitriolic.

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I should be fearful of wearying my readers; were I to enumerate any more experiments made in this general manner, as chemists are abundantly furnished with precipitants for this purpose.— Few can discover more than the preceding; nor do I believe, there are any which can render the component parts more manifest. And I am inclined to believe that the multiplying of experiments would rather tend to confuse than elucidate; I shall therefore desist from enumerating any more of these, and immediately proceed to those made on a larger scale.

One of my first observations; mentioned in a former part of this treatise, was, that a brisk and sparkling appearance took place upon pouring this water from one glass into another, when first drawn from the pump; and that the inner surface of the glass was covered with little air bubbles. From which circumstance alone I was inclined to believe that the water was plentifully stored with air; and from my former experiments with lime-water, by which I concluded it to be fixed air, I was led to make the following experiment: I put one quart of this water into a glass long-necked retort, which was about half filled; the end of which I plunged into a large tub of
common

common water; over this I inverted different jars, filled with the same; by which means all communication between the inner part of the jars and the external atmosphere was excluded. The apparatus thus fixed for the separation and collection of airs, has been, by the French, named "L'appareil pneumatique;" for which, whenever I have occasion to mention it again in the course of this analysis, I shall make use of the term "Pneumatic," chemical apparatus. I applied heat to the bottom of the retort; soon after which air began to be separated in small quantities, and by very slow degrees; which passing into the jars, caused the water to escape in proportion; and, according to the heat of the water, the air passed in greater quantities. After it had arrived at the heat of boiling water, the air was separated in a more rapid manner. I continued this process till the air was entirely discharged; and the water in the tub rushed into the retort, owing to a vacuum being formed between the end of its neck and the surface of the water. The air, which was collected in six different vessels, each containing eight ounces by measure, the whole consequently amounting to 48, was examined by means of lime-water and nitrous air: upon agi-

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tating the air contained in the first vessel in lime-water, a muddiness and cloud were formed, and a great part of the air was absorbed by the lime ; in the second a much greater was produced ; the lime-water, owing to its imbibing the air, ascended in the vessel to above half its height ; and in all the others it ascended still higher. The quantity of air remaining from the whole, which was not effected by lime-water, amounted to 20 ounces ; which was afterwards examined by the mixture of nitrous air with which it effervesced, and suffered a diminution in the same proportion as common atmospherical air. From this experiment I draw the following conclusion : that the precipitation produced by the lime-water, was because the fixed air of the Gloucester water, uniting with the lime, and being thereby absorbed, formed common calcareous earth in the form of chalk ; it likewise had the other characteristic marks of this acid ; hence I infer, that in one quart of this water 28 ounces of fixed air are contained ; and the remaining air, not affected by lime-water, was similar to atmospherical air, which was chiefly contained in the vacant space between the end of the neck of the retort, and the surface of the water ; and partly, although
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in small quantities, in the contents of the water itself.

From the ingenious experiments made by Dr. Black before-mentioned, we are taught that this air possesses all the qualities and characters of an acid, which is likewise confirmed by Professor Bergman; it is capable of being united with various solid substances as well as fluid; and such substances, according to the present Nomenclatura of chemistry, when saturated with fixed air, are said to be aerated, that is to say, they are suspended by an air, having the qualities and characters of an acid, in the same manner as such salts which are saturated with vitriolic acid are denominated by the term of vitriolated. This acid is capable of suspending various other bodies. The Honourable Henry Cavendish has endeavoured to prove, that various earths may be likewise suspended in water, by their being furnished with more than their natural quantity of fixed air, and shewn by experiments that this is the case in the Rathbone-Place water; from thence he concludes, that the unneutralized earth in all waters, is suspended by the same means, and justly observes, that it is very remarkable that earths should be rendered soluble in

water, both by depriving them of their fixed air, and by furnishing them with more than their natural quantity of it. That iron can be suspended in water by means of this gas, is fully established by the common experiment of impregnating waters with fixed air, by means of Nooth's apparatus. This acid constitutes the mineral spirit of most of the celebrated mineral waters, the escape of which will explain the change such waters undergo when they contain it in any considerable quantity. Upon this principle we can easily understand how, from exposure to the open air or heat, they will loose all their stimulating and invigorating powers, their pungency of taste, and likewise the deposit of the solid substances therein contained.

From the volatile nature of this aerial acid, we can understand the reason of the changes produced every day upon such waters, not only with respect to their briskness and clearness of appearance, but likewise to the quantities of substances held in solution by this acid. During the whole fortnight I remained at Gloucester, I could never, for two days together, produce the same effect with respect to quantity, although the experiments before-mentioned were repeatedly made after the
same

same manner; this could be owing to no other cause, than that in different states of the atmosphere the aerial acid or fixed air escaped in larger or smaller quantities, and of course their solid contents subsided to the bottom of the well, by which means the water became less impregnated with the different minerals.

It would be needless for me to mention other effects of this acid; I shall therefore conclude this subject in the words of Dr. Ash*, "That the discoveries of Dr. Black, Professor Bewly, Bergman, and others, have demonstrated the acid nature of fixed air, and have at last produced one uniform and simple system; and perhaps have left us little more to learn with respect to its properties as an agent in the formation of mineral waters."

I shall therefore proceed to my second experiment made on the large scale.

Experiment 2d.—I put two quarts of Gloucester water into a large glass jar, upon which I poured lime water, till it ceased to make any further cloud or precipitate; for this purpose a pint and a half were used; the liquor, after remaining twenty-four hours, was filtered, and the

* Vide his experiments and observations on the waters of Spa and Aix-la-Chapelle, page 25.

deposit was separated and dried. I tried most of the precipitants upon the liquor, by which no effects were produced; a small white cloud however appeared on the addition of a few drops of a solution of silver in the nitrous acid. The precipitate, which was of a whitish brown, weighed forty-five grains and a half; it was not soluble in distilled water. When I added vitriolic acid, an effervescence took place, owing to the separation of the fixed air, which had been imbibed by the lime; it formed soon after a white deposit, insipid, thoroughly insoluble, which proved to be selenite, formed by the union of the calx with the vitriolic acid. I filtered the liquor, to which I then added lixivium Tartari, and produced a fine white precipitate, resembling magnesia in appearance, taste, and chemical qualities; because when re-united with the acid of vitriol, I obtained Epsom salts: the weight of this precipitate, when separated and dried, amounted to twelve grains.

From this experiment I concluded, that in two quarts of this water twelve grains of magnesia were contained, chiefly suspended by aerial acid; because, had it been suspended by the vitriolic acid forming Epsom salt, it would, as being a saline

lime substance, have been soluble in water before the vitriolic acid was added.

If an explanation of the effects exhibited in this experiment should be required, I would give the following.—Primo, the precipitates being insoluble in water, was caused by the lime imbibing the superabundant fixed air, which has been so thoroughly spoken of before, that nothing more can be necessary; the addition of the vitriolic acid caused an effervescence, and uniting with the lime, formed an insoluble compound, known by the name of *gypsum selenite*, or *alabaster*; some portion of this acid did combine with the precipitated earth of magnesia, and thereby produced a soluble salt, which was taken up by the water. Upon this solution, when the lixivium of tartar was poured, another precipitate and a double decomposition took place, viz. the alkali united with the acid of vitriol, and formed vitriolated tartar, while at the same time the fixed air from the lixivium attached itself to the earth of magnesia, and thereby reduced it to the same state as when combined with the Gloucester water.

Experiment 3d.—I put two quarts of Gloucester water into another jar, similar to the for-

mer, upon which I poured an ounce of the caustic fixed alkali, whereby a whitish cloud was formed, and a sediment produced, which was separated by filtration and dried. The liquor was tried by all the precipitants; the Prussian alkali with an acid produced a blue; the other tests caused no change. The precipitate weighed thirteen grains and a half, which were entirely insoluble in water; upon the addition of vitriolic acid an effervescence arose, and a perfect gypsum was produced; hence I was inclined to conclude, that the whole thirteen grains and a half separated were nothing more than calcareous earth, partly selenetic, and partly aerated.

Experiment 4th.—In this trial I poured fourteen drachms of phlogisticated alkali upon the same quantity of the Gloucester water as in the two former experiments; the precipitate appeared ochreous, which, upon the addition of the acid of vitriol, changed to a beautiful bright blue; when separated by filtration and dried, it weighed nine grains. I repeated the same experiment, in order to have double the quantity of precipitate for examination. The powder of each, mixed together, weighed nineteen grains; the whole was then put into a crucible, and a strong heat applied;

plied; the blue colour was entirely discharged, and the powder then had the appearance of calx of iron, or ochre, and weighed thirteen grains. I then tried if any part of it was soluble in vinegar, and found that when separated again, it had lost five grains, which I looked upon to be calcareous or magnesian earth, accidentally precipitated by the alkali made use of, and that they were dissolved by the vinegar. The eight grains which were not soluble in this acid proved to be the calx of iron. I concluded from this experiment, that in one gallon of Gloucester water, eight or nine grains of iron are contained.

I now come to speak of the last experiment, in which most chemical professors place the greatest confidence; I mean, that by distillation and evaporation; this is considered as the most certain method of obtaining all the principles contained in mineral waters.

Objections have been made to the use of tests, as well as that of evaporation; the former have been considered as simply indicating the quality of the component parts, but not determining the real quantities of each. The process of evaporation has been objected to by Mr. Fourcroy, because that the action of heat sufficient to evaporate

porate the water, may produce sensible effects upon the principles therein contained, and thereby render the residuum dissimilar to the compounds originally existing in it. As both these methods were made use of in this analysis, we may be able to judge with greater certainty, both of the qualities and quantities of the component parts of the Gloucester water.

Experiment 5th.—Two quarts of this quarter were poured into a glass retort, and distilled to within five ounces to dryness, nothing volatile passed through the juncture of the retort and receiver. During this operation I observed the following phenomena: soon after the heat was applied, the separation of air was visible by the numerous bubbles emitted; a pellicle was soon formed on the surface of the water, which after encreasing gradually, began to break and fall down to the bottom of the vessel. This was nothing more than the different earths rendered insoluble in the water, from their being deprived of their aeral acid.

The liquor which was distilled over into the receiver was perfectly transparent and insipid; it was tried by all the precipitants, and no effect or change whatever produced. Three parts were
then

then evaporated away, the remainder was set by in a cold place, in order to see whether any crystallization would ensue; it remained there a whole night, and no change was observed; in short, the water was so pure that it might be used for the nicest experiments, like other distilled water prepared for the purpose. I next examined the liquor and powder remaining at the bottom of the retort; the powder was of a brown colour, and weighed thirty-five grains; the six ounces of liquid were high coloured when filtered, and very saline, containing a neutral salt, the acid of which proved to be the vitriolic; for when I put a few drops of it into distilled water, and then added one drop of a solution of mercury in the nitrous acid, a turbith mineral was produced: the alkaline substance proved to be earth of magnesia, because, on the addition of lixivium tartari to a few drops put into distilled water, a white magnesia was produced; the remaining liquor was then still further evaporated till reduced to one ounce, which when set by to crystallize, yielded of Epson salt fifteen grains.

The powder was next the object of examination. Upon this I poured two ounces of spirit of wine highly rectified; the vessel was shaken and
well

well stopped; the liquor after having stood some hours was filtered, I then weighed the residuum, which was not soluble in spirits of wine, and found that it had lost nothing in weight; from which I was certain, that although this water contained calcareous earth and magnesia, yet they were not combined with the muriatic acid, because each of these earths, when neutralized by this acid, are soluble in spirits of wine, although not when combined with the vitriolic. This is an additional reason in favour of the presence of the vitriolic acid.

Upon this I next poured boiling distilled water, which I suffered to remain a whole night; the powder when separated was not diminished; the liquor when filtered was nearly insipid; it was afterwards evaporated, and no crystallization appeared; hence there was reason to suppose that no saline substances were taken up from the powder in this operation. I was from this circumstance certain that what remained was of an earthy nature; and on account of its brown colour, and the result of some former experiments, I had no doubt of iron entering into this composition. I next digested it with a gentle heat in distilled vinegar; the greatest part of it was then dissolved.

The

The solution when filtered was next examined by means of the acid of vitriol, by which I obtained a selenite, formed by the union of the vitriolic acid with the chalk, and Epsom salt, formed by the union of the earth of magnesia with the vitriolic, which as being soluble was held in solution in the liquor above. These were both examined apart; from the one I obtained of magnesia twelve grains, and the others of calcareous earth fifteen grains.

The powder which remained insoluble in the acetous acid weighed four grains, which proved to be calx of iron.

I have now related to my readers the result of all my experiments, and hope that if there are any inaccuracies in the conclusions drawn therefrom, they will be viewed with an eye of candour, and attributed to the shortness of the time allotted me for my undertaking.

From the general experiments I think it will appear demonstrated, that in this water are contained fixed air, calcareous earth, magnesia and iron; and from my experiments when made upon the larger scale, I think that these substances exist in the following quantities in each gallon of this water.

Of

Of fixed air, or acidulous gas, by measure	28	oz.
Calcareous earth combined with the same	30	grs.
Aerated magnesia	-	-
Aerated iron	-	-
Epsom falt	-	-
	24	
	8	
	30	

I cannot conclude the analyfis without comparing the Gloucester water to those situated near the German Spa. They all contain the same materials, except that in the latter a small portion of mineral alkali and sea falt are combined, which I have not been able to discover in any of my experiments upon the former. It has been shewn by others from their analyfis, that a larger quantity of fixed air is present in them than in the one submitted to my examination.

Upon the whole, there appears a great similitude between them in their other contents ; and that where benefit is to be expected from the one, it may also be hoped for in the other.

I shall now conclude this part of my treatise, and in the next chapter consider the various diseases in which this water may be of service.

C H A P. III.

IN this part of my treatise it was my intention to have confined myself to merely giving an account of the diseases in which this mineral water may be of service; but, with the permission of my readers, I must beg leave first to dwell a short time upon the use and abuse of mineral waters in general.

In the same manner as the fame of men has often encreased or decreased from trivial accidents, so likewise have some medicines frequently acquired very high repute without possessing any real or essential merit; while others of genuine worth have, owing to misapplication, or false conclusions drawn from their operations, fallen into disrepute. Thus the public have, I believe, often been deprived of very valuable remedies by too rash and imprudent use of them at first; but in no instance is this more fully exemplified than in the drinking of mineral waters; in these, as in many other instances of human life, the noblest bounties of nature are often abused.

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The greater part of mankind are, I am sorry to own, too fond of being their own physicians at all times, and at the beginning of most diseases; till, after tampering with their constitutions for a length of time, the disease has gained such power that medical advice comes too late, and death is the effect of their folly.

With respect to the drinking of mineral or chalybeate waters, men in general will be governed by their own opinions, or those of their friends, who, for want of company, will oftentimes inconsiderately induce them to follow their examples; by which imprudence many, who in health having wantonly tried the experiment, have produced violent acute diseases, or sown the seeds of some inveterate chronic disorder, and be obliged to drag on a wretched and miserable existence to the remainder of their days. One cause then of a mineral water's not gaining the credit it may deserve, is the drinking of it without previous medical advice; surely then it behoves every one to pay attention to this circumstance, and never to suffer himself to be led away by the importunities of his friends. Medical men there are, beyond all doubt, who from having no faith in the use of such waters, or any
native

native chalybeate yet known, may in some measure dissuade their patients from frequenting such places; but these men I would advise my readers to ask this simple and plain question, viz. Can any harm, in certain cases, be derived from the use of them? if they are answered in the negative, I then leave it to their own discretion, which ought to guide them, to give such waters a fair trial before they condemn them.

A second cause of mineral waters either gaining or losing credit, is the manner of taking them, as it respects the quantity or frequency of use; for, as they are generally to be used only in chronic diseases, most of which have existed for a long while, the effect of habit is with difficulty overcome; and people, not aware of this circumstance, are unwilling to give them a fair trial, either through ignorance or impatience; by which means such waters have often fallen into discredit. Upon this subject Dr. Oliver makes a very just observation: "Patients (he says) instead of following the rules laid down for their conduct, torment themselves continually with doubts and scruples: by harkening to the opinion of every pretender, they come to have none of their own to act by. They trifle away their
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whole time after a fruitless search after what they should do, instead of doing what they ought, till at last, finding they receive no benefit, or are worse than when they came, they condemn the waters, and quit them in disgust."

There is an opposite absurdity, of which daily instances may be seen, from a ludicrous idea that too great a part of the world entertain, I mean the impossibility of having too much of a good thing; hence the blessings of life too frequently become the sources of misery: thus, although the drunkard may at the latter part of his days condemn the generous juice of the grape; yet I believe no one will deny that wine, which may destroy the intemperate man, is adapted for the support of life, when used with moderation and judgment.

Other causes there are which may be of disadvantage to watering-places—the want of good regulations in exercise, diet, sleep, and public amusements. With respect to the latter, I shall say a few words, and pass over the three former, until I come to speak of the regimen, which I would wish to lay down for the use of invalids resorting to this mineral spring.

Although it is by no means my desire to depreciate the medicinal properties of mineral waters;

waters; nor do I think that the minds of people frequenting these places, are necessarily affected with disagreeable and painful anxieties (which however may frequently be the case), yet I have no doubt, and it is universally allowed, that medicines of the greatest virtue would often fail, were there not means to divert and amuse the mind, and thereby assist them in their operation.

This observation is not confined to the hypochondriac alone, but is equally applicable to invalids in general. Many there are who, from want of employment, would pass their time in such a state of insipid inactivity, that the stimulating and cordial powers of a mineral water would soon cease, and thereby lose their efficacy, were it not for the exhilarating influence of public amusements. Although I am such an advocate in their favour, yet I must acknowledge that unless they are so well regulated as to prevent excess, the whole of the intentions would be frustrated.

The city of Gloucester and its environs are so well known, that it is unnecessary for me to add to what is already mentioned in my first chapter, owing to its being surrounded with beautiful hills and vallies; the rides and walks are numerous

and delightful; the town has agreeable amusements; public breakfasts twice a week during the season; balls, concerts, and a theatre.

From the chemical analysis given in the preceding chapter, we find that this spring contains a considerable quantity of fixed air, iron, calcareous earth combined with acidulous gas, magnesia, and Epsom salts; hence it may, with propriety, be called a native chalybeate water. My next object will be to inform my readers of the diseases in which this water may be serviceable. I shall for this purpose mention the virtues which each of the constituent parts of this water possess in their separate state, beginning with iron.

This valuable metal has long been known in the practice of physic, for its great utility in a number of diseases, proceeding from laxity of fibres, and in local as well as general debility. It has very properly been ranked under the class of tonics, among which it stands almost the first, and is used only in chronic diseases depending upon such causes. Here it may be necessary to explain the use of two technical terms in the science of medicine. Chronic is a term derived from the Greek word $\chi\rho\nu\omicron\varsigma$, or *chronos*, signifying time; comprehending, therefore, diseases which

which have been of long standing, and in which there is not immediate imminent danger, in order to distinguish them from the opposite diseases called acute; of which kind are fevers, pleurifies, inflammations, &c. &c. by which the sick are generally confined to their beds, and their diseases terminate, either favourably or unfavourably, in the space of a few days: in these the pulse is generally full, quick, and throbbing, and evacuations are necessary; in the former, muscular motion is performed with difficulty; the pulse is languid and feeble, and general debility prevails. Hence, in chronic diseases strengthening remedies are required; and as the strength of muscular parts is supposed to depend much upon the tension of their fibres, such remedies as produce that effect are called tonics.

This metal is almost the only one which is not virulent; it is often ordered in prescriptions in every shape, both that of its metallic state, and that of its calciformed; by which is meant, iron in the state of rust. It is also used when united with an acid, which is one of the most common principles that keeps it suspended in mineral waters. The great advantage certainly proceeds from its tonic and strengthening qualities. It

produces a slight and gentle irritation of the fibres, and thereby the sensible organ of the body on which it may act are constringed, and an additional force and elasticity necessarily produced. By its being applied immediately to the fibres and vessels of the stomach and intestines, the most salutary effects are produced in those diseases which are derived from the inactivity of the digestive organs; for which reason it is a remedy oftentimes given in cases of dyspeptia, or indigestion, and loss of appetite, attended with crudities and flatulencies. Dr. Cullen, in his excellent book entitled his Lectures upon the Materia Medica, speaks thus highly in favour of the virtues of iron, viz. “ In all cases of laxity and debility, and in obstructions and slowness proceeding from these causes, iron is employed, though other simple astringents might also answer the effect. Here we ought to be aware of too sudden an astringent, which might be attended with bad consequences; and, therefore, in exhibiting it in these cases, we should give it in small doses, and trust to length of time for a cure; and by this means we shall avoid those inconveniencies of which physicians often complain in their preparations of iron.

“ Mineral

“ Mineral waters often produce cures which we in vain attempt to perform by the combinations in our shops, even although these waters contain nothing but iron. This is manifestly owing to the weakness of the dose ; in proof of which we find, that the strongly impregnated waters seldom answer so well as those weak ones we commonly reject.”

This therefore is a strong argument in favour of what I asserted in the former part of this chapter, with respect to the patience necessary for invalids, in order that fair trials might be made of the utility of the water in question. They are not to go away dissatisfied on account of their having derived no benefit in the space of a week or a fortnight ; but should consider, that where diseases have continued for a length of time, the effects of habit are not so easily and speedily removed.

Hitherto I have only mentioned the local diseases of the stomach and intestines, in which this tonic is serviceable ; it now remains for me to speak of those by which the whole constitution is affected. I have before said, that in all cases attended with inflammation, chalybeates are prohibited ; but there seems to be an exception in

one case, I mean that of an intermittent fever; and even here such remedies are given in the intermediate days only; and under such regulations I have no doubt but iron has been administered with advantage. I by no means here wish to be understood to say, that I would recommend patients labouring under tertian or quartan agues to watering-places, in order to drink a chalybeate; yet, should they accidentally reside in those places, I should be tempted to order them a trial.

In cases of general debility, produced by fevers, and remaining long after the disease has ceased, I would recommend, in the most earnest manner, the use of such a water as that of Gloucester; by which, if it at first be taken in small quantities, and repeated twice a day together, with moderate exercise and free salubrious air, a constitution previously debilitated would in a short time be firmly re-established.

As nervous diseases of all denominations generally arise from debility, which by producing irritability, is the cause of them, I would recommend the use of the chalybeate, which is now the object of our enquiry, to the attention of those affected with such disorders.

Under

Under nervous diseases are to be considered paralytic affections of all kinds, after they have continued for some time. All cases of tremor, depending on debility, which too often arise from the improper and free use of coffee, tea, tobacco, &c. all those of languor, particularly when approaching to syncope or fainting, and likewise indigestion, attended with nausea, sickness, inflation, eructation, &c. Chlorosis, which is always a disease of the asthenic kind, and consequently attended with nervous symptoms, has been ranked by Dr. Cullen, in his Nosology, under the class of neuroses, or nervous disorders. This disease is generally attended with such a considerable laxity and flaccidity of the whole system, that in no one case is the use of tonic remedies more fully indicated, or are the salutary effects of chalybeates more fully demonstrated than in this disease: to such, then, I have no doubt but the frequent use of this chalybeate may be of service.

It may be here proper to say a few words with respect to the use of this water in other female complaints, which are not ranked in the same class of diseases; particularly where the menstrual flux may have been either retarded or im-
moderately

moderately encreased. In the former, when the patient is affected with fluggishness, lassitude and debility, with various symptoms of indigestion ; when the face loses its vivid colour, becomes pale and flaccid, and the breathing is hurried by quick and laborious motion of the body, and the heart is liable to palpitation, and syncope, or fainting, when attended with head-ache and pains of the back, there can be little doubt that such a suppression depends upon a general laxity and debility of the constitution, which thereby produces a weaker action of the vessels of the uterus : in such a case, the propriety of the use of the Gloucester water is evident, because, in addition to the chalybeate principle, there is joined a gaseous spirit, possessing such stimulating and invigorating powers, as may so restore the tone and sensibility of the vessels, that such an obstruction may be expected soon to be removed.

We next come to treat of the opposite disease, namely, the immoderate flow of the menses, which may proceed from too opposite causes, viz. that of too great an action of the vessels of the uterus, depending upon inflammation, in which the use of chalybeates would be imprudent ; or from too great a laxity of the exhalent vessels, by
which

which means such an evacuation often takes place, as to debilitate the whole constitution at large: in such cases chalybeates and mineral waters may not only be used with safety, but great relief may be reasonably expected.

There is one more disease to which females are liable, I mean the fluor albus. This from all its various symptoms, and from its arising from almost the same causes, which produce an immoderate flow of the menses, inclines me to suppose that a laxity of the extreme vessels of the uterus is its proximate cause, which, in great measure, explains why it so often follows or attends the disease above mentioned. As the effects of this are so similar to those in the former, particularly the debility prevailing in the functions of the stomach, I have no doubt but the same method of cure is to be attempted, only with less reserve with respect to the use of astringent and tonic remedies; hence, in such a case, chalybeate waters may be used with less fear, and with greater prospect of benefit.

Almost all the diseases called spasmodic, are to be enumerated in the catalogue of nervous*.

All

* Under this title Dr. Cullen comprehends all the diseases which consist in motu abnormi; that is, in a præternatural state

All these depend upon either some unnatural irritating causes, such as external injuries, pain, dentition, worms, the exhibitions of poisons, crudities in the stomach, &c. or, upon a certain state of the nervous system called irritability, by which it is præternaturally liable to be affected with the most gentle, simple, and common irritations, to which we are hourly exposed; and such as did not previously affect us when in a state of health.

As those diseases, depending on external causes, are removed when such causes have ceased, they are not considered as belonging to this class of diseases; I shall therefore not make any comment upon them in this treatise. I shall mention those only which arise from the irritability of the nervous system, which becoming constitutional diseases, more strictly are to be called nervous. These are convulsions, St. Vitus's dance, epilepsy; which latter, if it is not owing (as it is too often the case) to original conformation, but has been brought on in the course of life, and not been of too long a continuation, may admit of relief from tonic medicines. Much in my opinion may be

state of the contraction and motion of the muscular or moving fibres in any part of the body. Vide vol. 3d. page 275.

done

done to prevent and obviate the ill effects of the disease, by a continued drinking of chalybeates.

The remaining spasmodic diseases are palpitations of the heart, asthma, pyrosis, or water-brash, hysteria, cholera, diarrhæa, and all bilious complaints when free from fever. With respect to the two latter diseases, I by no means advise my readers to use such waters while they are labouring under them; but am fully convinced they may be used, with the greatest propriety, as soon as they are in some measure recovered; by which means a speedy relapse, which too commonly happens, may be prevented.

I come now to point out the remaining chronic diseases in which chalybeate waters may be of service, and in which I believe more real benefit is to be expected. These are chiefly classed under the name of Cachexiæ*, such as tabes, producing emaciations, hectic fevers, ephidrosis, or profuse sweatings, dropries of all kinds, whether anasarca, ascites, or hydrothorax, scrophula, scorbutus, and jaundice.

Dropries almost universally depend upon debility, too often brought on from improper modes

* Derived from the Greek χαχος, malus, bad, and εἶς, consuetudo, habit.

of living; and is a disease to which the human frame is most subject. It may arise from two different physiological causes; viz. a laxity of the exhalent vessels; by which so much water will be poured out into the different cavities of the animal frame, that the absorbents may not be able to perform their office; hence the fluid will accumulate: or although these vessels may not exhale too much; yet the absorbents may be so far advanced in a state of relaxation, that they cannot take up the ordinary quantity thus poured out; hence too causes may be conjoined; and as debility will produce these two effects, it becomes too generally an incurable cause of dropsy. Surely, then, in such a disease, tonic remedies are to be used; and I know from my own experience, that where those of the strongest have failed, the administration of mineral waters, containing very small quantities of iron, has often produced the most happy effects.

With respect to scrophula, or king's evil, I shall only make an observation or two. This disease seems particularly connected with debility; and experience shews us, that the more the constitution of children and others is invigorated, the malady in proportion decreases. This
water,

water, as a chalybeate, may be serviceable in this disease, by the power it possesses besides, as a general stimulus, by which it may pervade the lymphatic system, disburden obstructed glands in remote parts, encrease a secretion from the intestinal glands, and thereby discuss glandular tumours in all parts of the system. There is likewise reason to believe, that the external application of this water, when tepid, may be of service in the healing of scrophulous ulcers.

Since the ingenious treatise upon scurvy and putrid fevers, published a few years since by Dr. Millman, wherein he has used such strong arguments to overthrow the opinion, that these diseases depend upon any natural tendency of the fluids to putrefaction, and to prove that their causes arise from a deficiency in the moving powers; I have little doubt of the efficacy of chalybeates, not only towards curing, but also towards preventing such inveterate diseases, formerly too prevailing where a considerable number of people were confined together.

Having mentioned all the effects of iron as a chalybeate, the next thing that falls under my consideration is fixed air; the effects of which, when introduced into the constitution by means
of

such as frequently attend them in a state of atony; From this view, the general indication of cure must be to restore the activity and vigour of the vital principle in the part * ; and there is reason to assert, that chalybeates and stimulants will be of service in this disease.

By so general and universal a stimulus as fixed air, all the secretions and excretions are kept in a proper balance, provided not improperly used, by which means the perspiration is constantly preserved. There is reason, therefore, to suppose, that in cases of leprosy, and other obstinate cutaneous disorders, if this water is used in a regular manner, it may not only often give considerable relief, but eradicate the disease.

I come now to speak of the antiseptic qualities of fixed air. Although this air, when taken copiously into the lungs by means of inspiration, proves to be a most immediate and powerful poison; yet, when received into the stomach and intestines, great benefit has been received. This air has been considered by Dr. Hales, as the principle which cements the solid particles of animal bodies together; and Dr. Macbride en-

* Vide Dr. Cullen's First Lines of the Practice of Physic, p. 34. vol. 2d.

deavours further to shew, that without the extrication of this air, no putrefaction can happen; and that even by the absorption of it, putrefied substances may be corrected and rendered sweet. Having exposed putrid matters to the vapours arising from fermenting mixtures which generated this acid, he found the putrid quality was destroyed; and hence he considers this air as a powerful antiseptic. Fixed air, when received into the body, has always been ranked as the first antiseptic, in cases of violent scurvy and putrid diseases; and when it enters into the combination of water, or other liquors, it not only has an antiseptic power, but acts also as a strengthening and corroborating medicine.

That great benefit has been received by people labouring under violent scorbutic affections, appears evident from the beneficial effects of spruce beer, when taken freely upon long voyages; of which we have many instances related by Captain Cook, and others.

Various have been the means of exhibiting this valuable medicine internally. One of the best methods made use of in this country, is that by means of Mr. Nooth's apparatus for making artificial mineral waters, which is now so well

understood as to require from me no explanation.

From these and other circumstances we have reason to believe, that those waters, in which this mineral spirit forms a constituent part, contribute very much to encrease the tone and vigour of the constitution; and there can be no doubt but the corroborating effects are greatly encreased, when united with that excellent chalybeate before mentioned.

I come next to speak of the absorbent earths, chalk and magnesia, which are contained in the Gloucester water. These have always been considered as correctors of acidity, whenever they meet with it either in the stomach or intestines, and thereby become useful medicines wherever there are crudities, which arise from indigestion, thereby producing eructation, flatulence, heartburn, and the like. Magnesia, besides its absorbent quality, proves a gentle laxative; and therefore, after having corrected acidities and vitiated bile in the first passages, it will tend to promote their expulsion.

From the small quantity of Epsom salt contained in this water, I doubt whether any benefit can be expected from it as a purgative. I have
been

been informed by some who used it frequently, that such effect has often taken place: it is said by some, that the purgative quality of salts is greatly heightened by dilution; and that a quarter of an ounce, contained in the Cheltenham water, operates more briskly, than a whole ounce of common glauber salts, when dissolved only in two ounces of common water. This circumstance may not appear so strange, if we reason from analogy, which teaches us every day, that the effects of medicines are not always in proportion to the quantity, but often varies according to the difference of the formula in which they are prescribed.

I have now mentioned nearly all the diseases in which this chalybeate water may be serviceable; each of which appear to originate from a want of vigour and mobility in the nervous and muscular system. From the medicinal qualities which it possesses, there is every reason to suppose, that great benefit may be received in all those diseases upon which I have treated; and when we consider that some of them may arise from mechanical causes, far beyond the reach of medicine, we are not to attribute the want of success to the inefficacy of the water.

Since my return from Gloucester, and even since some of these pages have been committed to the press, I have been favoured with the following letter from the Honourable Mr. F. B. which cannot be introduced more properly than at the end of this chapter.

“ S I R,

“ I should really consider myself deficient in gratitude, were I to omit informing you, that hardly a week passes that does not convince the public, more and more, of the justice of your judgment relative to the Spa water here. No one can with greater justice and propriety than myself speak to it.

About a month ago I arrived here, and immediately began to drink the water three times a-day, which has actually cured me of a dreadful scorbutic complaint, which for years past had baffled every attempt of the faculty to cure. I was also subject to a rheumatic and nervous complaint, the former almost gone. I had for several months continued the use of the water of a celebrated English Spa, without effect (indeed I
had

had it brought to my lodgings); in short, I am greatly mended in my health, in every respect, within this month past. I am, Sir,

Your most obliged humble servant,

Gloucester,
June 15, 1789.

F. B.

DOCTOR HEMMING.

C H A P. IV.

UPON this subject I believe very little is necessary to be said. What I have to offer, I shall arrange under the following heads:

1st. The regimen, which respects exercise, diet, and sleep.

2dly. The preparation to be observed previous to drinking the water.

3dly. The quantity of water necessary to be taken at each time.

From the observations I have formerly made upon the use and abuse of mineral waters, which are by no means confined to them alone, but are equally applicable to any medicines; whether bark, chalybeates, mercury, or others, it becomes necessary for every one who expects re-

lief from either, to submit to a regular attendance ; he must therefore arm himself with a stock of patience and perseverance ; and to these he must join temperance of every kind.

R E G I M E N.

Exercise.—Exercise is conducive to health in all places, and at all times ; I would therefore advise those who frequent mineral waters, to rise early in the morning, because they may then take it with greater ease, and be less incommoded than in the heat of the day.

The exercise of riding, or walking, greatly facilitates the operation of all such waters ; but it should not be protracted beyond the strength of the patient ; it promotes their efficacy, by preventing their passing too quickly by urine ; and if a gentle perspiration, which does not amount to a sweat, can be produced, it promises benefit. I would likewise remark, that exercise should ever be used between the draughts of the water ; and that of walking briskly is to be recommended.

Diet.—As most of the diseases to which this water is applicable depend upon debility, a generous diet, together with a moderate use of the
juice

juice of the grape, ought to be recommended: there may, however, be certain diseases in which such general advice would be improper. Animal food can hardly ever be injurious, provided it is prepared in the most simple manner; I mean, where the flavour is not heightened by the addition of made gravies; and in all cases, plain roast or boiled meat, whether butcher's meat, or poultry, is far preferable to made dishes. This kind of food should only be taken once a day, and that at dinner. Broths of all kinds may be of service, provided they do not approach to the nature of *rich* soups. These, however, in the hot months of summer, would much better be entirely omitted.

Although there is an acid present in this water, yet it by no means operates as an objection to the invalids using milk, while drinking it. Dr. Ash, in his analysis of the German waters, which contain a much larger quantity of fixed air than the Gloucester, observes that there is not a single instance where milk ever disagreed with any person from the bare use of the Spa water at the same time; and therefore says, that whenever a milk diet is proper, that will be no objection to the use of Spa water at the same time.

The

The drinking tea twice a day is certainly improper, as it seems fitted to answer a different indication than a chalybeate water, and of course renders the virtues of it less effectual. Cocoa, or chocolate, with milk for breakfast, is in general preferable to tea or coffee.

Sleep.—When I recommended exercise, I mentioned the necessity of using it at an early hour; in order to put this in practice, the necessity of going to bed by eleven at furthest, appears evident. A proper quantity of sleep is necessary, not only for the preserving of health, but is more particularly demanded for invalids, debilitated by disease; by assisting the organs of digestion, it contributes to the nourishment of the body; for it is observed by all physiologists, that although they operate more slowly during sleep, than in the hours of watchfulness, yet their functions are performed in a more perfect and regular manner. Surely then the necessity of sleep for invalids frequenting a mineral water, does not require further recommendation.

The passions of the mind should likewise be attended to; they should be kept within bounds; every excess exasperates the distemper, hinders digestion, and consequently debilitates. All such pursuits

pursuits as relax the constitution, and render the nervous system too exquisitely sensible, are to be avoided.

PREPARATION NECESSARY.

Few preparations are necessary to the drinking this water; but its virtues may be assisted and encreased by the administration of a medicine or two previous to using it. As the purgative quality of this water is so trifling, it may be necessary to cleanse the first passages by a gentle cathartic; this may be repeated every week or fortnight afterwards, according to various circumstances; for it has been observed, that when this has first been neglected, mineral waters have oftentimes disagreed, but afterwards they have agreed very well.*

Dr. Sutherland, in his analysis of the Bristol waters, observes that bleeding may be a necessary preparative for those who sport with the waters, or drink them because they would not be out of the fashion: but as in most disorders for which they are proper, bracing and strengthening seem to be indicated, this evacuation not only seems useless, but appears pregnant with danger. What

* Dr. Rutton on Mineral Waters, page 333.

is applicable to the Bristol, is equally so to the Gloucester mineral water. I would not recommend this evacuation as preparatory. If, however, any inflammatory fixed pains, giddiness, or plethora, should be brought on by the use of it, a small evacuation by bleeding may be necessary.

SEASON FOR DRINKING IT.

As this water is, undoubtedly, much better, on account of its greater strength, in a serene and dry state of the air, than when the weather has been rainy and cloudy for a length of time, the summer season is best calculated for its use; to which we may join the greater convenience of taking exercise. In general, it may be used from the month of April to the end of October. It, however, may be drank in the very middle of winter, provided it is used during the time of a frost, as, at such a period, I believe its acid may be much stronger, and thereby the water may be more impregnated with its solid contents; if, however, it should be used in such a season, the necessity of exercise afterwards becomes more urgent.

Quantity.—I am now come to my last division, upon which I cannot offer any thing that can be
very

very useful to my readers. The quantity proper for one, may by no means be adapted for others: I think, however, it may be a necessary caution to advise them not to use it too freely at first. The idea of drinking large quantities is very erroneous, for by the means this water may pass off so quickly, either by the bowels, or by urine, that very little advantage to the constitution at large can be derived.

I should think it advisable to begin with drinking a quarter of a pint in the morning before breakfast, provided there is an hour allowed for exercise after its use. This is an additional reason for the necessity of early rising. If, after a trial for four or five days, it has not had any improper effect, I would recommend the dose to be encreased to half a pint, and more. During the hot weather, it would be imprudent to drink of it in the middle of the day, though in the winter this time would be most advisable. When the heat of the day is decreased, a second glass would be useful, provided there is a sufficient time between the taking of it, and the hour of supper, for exercise, whether that of riding or walking.

I have now completed the different heads of my treatise, according to the arrangement mentioned

tioned in my first chapter. I have only to lament the very inelegant and inaccurate manner in which this treatise appears, owing to the advanced period of the season, which demanded the immediate publication. If, however, indigested as it may appear, it should answer the purpose intended, viz. the establishing of the utility of the mineral spring, which has been the object of my consideration, *my wishes* are accomplished, a considerable advantage will accrue to the city of Gloucester, and the great and expensive undertakings of Mr. Lewis, the proprietor, will be crowned with success.

F I N I S.

*At the particular Request of Mr. LEWIS, the
Proprietor of the Gloucester Water, I insert
the following Cases.*

C A S E I.

I BETTY GARLICK, in the parish of Elstone, near Birdlip, in the county of Gloucester, was for several years afflicted with a leprosy. The faculty gave me little hopes of recovery; but, by hearing of the Gloucester Spa Water, I procured some bottles of it, which I drank, and in about eight weeks the skin of my flesh became sleek and smooth, and am now actually cured of this grievous disease. In witness hereof I sign my name to the above cure.

The mark of ✕ BETTY GARLICK.

JAMES BENNET, Overseer,
WM. GORDON, Churchwarden. }

Dec. 31st, 1788.

C A S E II.

ELIZABETH MORGAN, Berkeley-Street, Gloucester.—I was violently attacked with the rheumatism, and was an out-patient in the hospital, but found no relief. I was so exceedingly bad that I was confined to my bed for sixteen weeks; by a constant application to the Gloucester water for two months, I was perfectly relieved of the excruciating pains; the truth of which I certify by setting to my hand.

The mark of ✕ ELIZABETH MORGAN.

C A S E

C A S E III.

JANE HARRIS, of Upton, St. Leonard's.—I was grievously afflicted with a dreadful disorder called the king's evil ; so bad, that I was incapable of helping myself, and was upwards of twelve months in Gloucester Infirmary, and came out incurable, without any relief.—My death was expected.—I was advised the Gloucester Water, which I drank for some time, and washed my wounds therewith ; and I am now in a fair way of recovery.

Certified by PETER SNELL, Esq.

WM. ABELL, Churchwarden.

C A S E IV.

Gloucester County Gaol,

S I R,

January 3d, 1789.

AS my affairs are happily fettled, and I am about to leave Gloucester, I beg leave to return you my best thanks for the use of your Spa Water, which I have gratuitously partaken of during my imprisonment. My case was scorbutic, attended with extreme dejection of spirits, loss of appetite, and painful weariness in my limbs : by the use of the water for about three months, I am perfectly relieved in all these respects ; and for the sake of others who may labour under the same affliction, you are at liberty to make what use you please of this my declaration.

I am your grateful
and obedient servant,

Witness W. JARVIS.

OLIVER ALKEN.

To Mr. LEWIS, at the Spa,
in Gloucester.

* * There are many other Cases which might be inserted, all of which may be seen by applying to Mr. Lewis.









